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EMERGING MANAGEMENT ISSUES OF AUTOMATIC DATA PROCESSING IN THE DEPARTMENT OF DEFENSE

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EMERGING MANAGEMENT ISSUES OF AUTOMATIC DATA PROCESSING IN THE DEPARTMENT OF DEFENSE

by

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PREFACE

This paper has been written to explore some of the important managerial issues which have arisen in the Department of Defense with the introduction and expansion of automatic data processing. These issues are examined from the writer's point of view as a prospective manager on the scene, but not in the act. Several significant problems are explored to determine what future military commanders will have to consider as the implications of automatic data processing become more widely felt throughout the Defense Department. This work is based upon the courses taken as a graduate student in the Navy Financial Management Program at The George Washington University and the information gathered from outside readings on this subject of personal interest to the author. The assistance of Commander James D. Harlan, USN, and Mrs. Helen McNulta is gratefully acknowledged for inspiration and editorial consultation.

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CHAPTER I

INTRODUCTION

During the past decade the Department of Defense has moved into the automatic data processing field and new management problems have accompanied this evolution. Many issues have been raised and many questions asked for which there is no easy answer, if any at all. These changes have called for a whole new concept of thinking on the part of military managers. Decision-making is taking place in an atmosphere in which traditional organizational relationships, classical problem-solving techniques, and past experience offer little assistance in formulating value judgments necessary for the decisions. Government and defense activities have grown to such proportions that management is faced with a wealth of information and is unable to utilize it. More difficulties have been experienced in the automatic data processing field because of lack of management planning than inadequacies in computer technology. Thus, the continuing study of the emerging management issues is of utmost importance if past errors of judgment are to be avoided and the real potential of this modern technology realized. By

applying the analytic use of management control techniques and building on the considerable framework left behind by his predecessor, Secretary of Defense McNamara has beefed up the nation's nuclear and conventional forces, unified the technical supporting services, junked millions of dollars worth of dubious projects, and revolutionized the entire budgetary system.[1]

The profound effect that the computer will play in this new era has been aptly described by Ralph J. Cordiner, General Electric Company:

> When the history of our age is written, I think it will record three profoundly important technological developments:
>
> Nuclear energy, which tremendously increases the amount of energy available to do the world's work;
>
> Automation, which greatly increases man's ability to use tools; and
>
> Computers, which multiply man's ability to do mental work.
>
> Some of our engineers believe that of these three, the computer will bring the greatest benefit to man.[2]

This treatise on the effects of changes in the processing of information in the Defense Department may properly begin with definitions of the basic terms which will be used repeatedly and which may appear in abbreviated form in quotations. The glossary published by the Bureau of the Budget provides the following

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[1] Alfred L. Baumann, Jr., "Managing an Expanded Horizon," Data Processing, September, 1962, p. 12.

[2] "A Business Week Special Report on Computers," Business Week, June 21, 1958, p. 3.

definitions:

> Data Processing--the preparation of source media which contain data or basic elements of information, and the handling of such data according to precise rules of procedure to accomplish such operations as classifying, sorting, calculating, summarizing, and recording.
>
> Automatic Data Processing (ADP)--data processing performed by a system of electronic or electrical machines so interconnected as to reduce to a minimum the need for human assistance or intervention.
>
> Electronic Data Processing (EDP)--data processing performed largely by electronic equipment.[3]

Background

The Department of Defense has over two-thirds of the computer inventory and one-half of all punched-card equipment used in government. It is the largest single user of automatic data processing in United States today. Yet few military personnel have even seen a computer. They are known only by what is read or heard about them, and much of this information is erroneous and misleading. A computer cannot think, reason, or create. It can take in information, store it, or perform calculations on it in accordance with instructions put into the machine, and it can put out logical answers.

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[3] U. S. Bureau of the Budget, Automatic Data Processing Glossary, December, 1962, p. 40.

Computers have been developed while most service personnel were tending to the routine jobs of manning the ships, flying the aircraft, conducting field maneuvers, and processing the paperwork of the military. Today there are two and one-half million servicemen and women, but only a small group of 18,000 is actually involved in the day-to-day operations of Defense Department computers. Of the one million civil service employees in Defense only about 31,000 are working in data processing billets.[4] It is little wonder that so few service personnel have any knowledge or appreciation of the developments in the past few years which will affect their lives, their careers, and the future of military management.

It is readily apparent that electronic data processing has already become "big business" within Government since the introduction of the first computer in 1950. As of June 30, 1963, there were 1,248 computers in use in the Federal Government, with a total annual cost of $705 million. The Defense Department alone operated 1,046 units at a cost of $447 million. The Bureau of the Budget has estimated that by 1966 over 2,100 computers

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[4] U. S. Congress, House, Committee on Post Office and Civil Service. Hearings on the Use of Electronic Data Processing Equipment, Part 1 - Comptroller General and Department of Defense, 88th Cong., 1st Sess., June 11, 1963, p. 27. Cited hereafter as House Committee on Post Office and Civil Service, ADP Hearings, 1963.

will be installed with an annual budget in excess of one billion dollars.[5]

Expenditures of this magnitude have focused sharp attention on management practices, policies, and procedures in the various departments and agencies. The President has directed the Bureau of the Budget to make annual inventories of all automatic data processing equipment in the Federal Government, except for equipment which is used in military operational and certain classified activities within the Department of Defense.

The Congress of the United States has conducted annual hearings on the use of electronic data processing before the Committee on Post Office and Civil Service. A bill now pending legislation in Congress, the Brooks Bill, would "authorize the Administrator of the General Services Administration to coordinate and otherwise provide for the economic purchase, lease, maintenance, operation, and utilization of automatic data processing equipment by Federal departments and agencies."[6]

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[5] U. S. Congress, House, Committee on Post Office and Civil Service, Inventory of Automatic Data Processing Equipment in the Federal Government, 88th Cong., 1st Sess., October 25, 1963, p. 11. Hereafter cited as House Committee on Post Office and Civil Service, ADP Inventory, 1963.

[6] U. S. Congress, House, H. R. Bill 5171, passed by the House on July 18, 1963. Read in the Senate and referred to the Committee on Government Operations on July 22, 1963. Not reported out as of May, 1964. 88th Cong., 1st Sess.

The General Accounting Office has conducted numerous investigations into expenditures for automatic data processing equipment over the past several years. A summarization of findings is contained in the following statement by Joseph Campbell, Comptroller General, in testimony before the House Committee:[7]

> . . . a number of points which are in need of careful attention in individual agency electronic systems programs:
>
> 1. Need for continuous efforts to improve source data and control over documentation procedures and to improve management analysis and scientific techniques.
> 2. Need for master planning and development of integrated systems within each agency.
> 3. Need to eliminate unnecessary reports and duplication in processing procedures when converting to electronic systems.
> 4. Need to analyze systems to determine optimum data processing cycles in relation to cost and value of information produced.
> 5. Need for more specific and systematic measurement of costs and progress in development of electronic systems to establish a basis for more effective management control over their acquisition and use.
> 6. Need for participation and support by top management in order to develop the most effective use of this new technology and need to insure management participation in long-range planning efforts for the development of integrated agency systems.

In addition, the House findings have indicated a need for more positive long range planning, more effective and economic

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[7] House Committee on Post Office and Civil Service, ADP Hearings, 1963, p. 5.

use, a desirability of purchasing rather than leasing equipment, and a need for central management to direct and coordinate a Government-wide program of procurement and utilization.[8]

These important management issues highlighted by the Comptroller General and the House hearings on automatic data processing in the Federal Government deserve the considered attention of management in the Defense Department and provide the subjects for further examination in this paper.

Chapter II briefly outlines the history of automatic data processing development in the Defense Department. Chapter III explores some of the organizational problems evolving at various levels in Defense. Chapter IV examines some of the pressing personnel problems relating to the introduction of electronic data processing equipment. Chapter V discusses the issues in the procurement area. Chapter VI investigates the limitations, pitfalls, and barriers to success of automatic data processing installations. Chapter VII contains the summary, conclusions and recommendations.

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[8] Ibid.

CHAPTER II

HISTORY OF DATA PROCESSING IN DEFENSE

Department of Defense

The following brief summary of a statement delivered by A. T. Bishop, Staff Director, Data Systems Division, Office of the Assistant Secretary of Defense (Installations and Logistics) before the House Committee, best explains the background of data processing in the Office of the Secretary of Defense.[1]

During the period 1952 to 1954, Defense activities installed three electronic computers on an exploratory basis to assist in performing mobilization computations and logistics management functions. The abilities of these ADP systems to assist in the day-to-day management and long-range planning of the Department of Defense were readily established, so that by January, 1957, 61 computers were installed at Defense activities performing business management information processing functions. The annual rental bill for the January, 1957 inventory of Defense computers was $7.8 million. Three of these computers were purchased by the Government.

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[1] House Committee on Post Office and Civil Service, ADP Hearings, 1963, p. 22.

By June 30, 1964, military service and Defense agency ADP installations will number well over 1,000. Computer rental costs have gone from $75.2 million in 1960 to $173.6 million in 1964. The total cost of the Defense ADP program for fiscal year 1963 was $447 million, which included all rentals, supplies, personnel salaries, and capital outlays directly attributable to ADP systems.

The size of the Defense ADP program and the integral part which ADP systems play in Defense operations have justified an extensive management program. This program provides for the effective management and economy in operations throughout the Defense Department by optimum use of data processing services. This objective will be achieved by: (1) the attainment of optimum uniformity, compatibility, and responsiveness of automated data systems between and among Defense components, (2) the elimination of unnecessary duplication and overlapping effort in systems developmental activities, and (3) the interchange of improved ADP techniques, computer programs, and management procedures.[2]

Department of the Army

The following statement by Brigadier General Robert N. Tyson, Director of Management, Office of the Comptroller of the

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[2] *Ibid*., p. 23.

Army, briefly summarizes the history of the Army in the data processing field.[3]

Prior to World War II the Army was basically a small training force of less than 200,000 men and the supporting administrative and logistical organization was small. Paperwork was largely processed by manual methods and conventional machines such as the desk calculator, adding machines, typewriters, and the like.

With the rapid buildup in preparation for war, the needs of the Army in supply, weaponry, and support activities resulted in a widely expanded work force to accomplish the support mission and to process the heavy volume of paperwork. Mostly affected were the business-type areas of finance, personnel accounting, obligation and expenditure accounting, medical statistics, and a wide variety of servicemen's benefits which resulted from congressional action.

There was little doubt that conventional machines available in the late thirties permitted more output per hour. At most, however, they only slowed the rate of growth of the clerical force which represented a large paperwork Army itself. Despite this rapid increase in the clerical force, its ability

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[3] *Ibid.*, p. 70.

to cope with the ever-mounting data processing requirements had not increased.

Commencing in 1940 it became apparent that with the rising administrative workloads, new methods of data processing had to be explored. The use of punched card machines (PCM) was studied and a vast program of converting from manual to mechanical methods got underway.[4]

The major Army PCM programs involved the mechanization of accounting operations, personnel accounting systems, supply operations at depots and stock control points, servicemen's benefit programs, communications, and a wide variety of other activities.

The use of PCM by the war's end was general throughout the Army. With the maintenance of a large peacetime force and the necessary support organizations, there was little reduction in PCM. In fact, the Army conducted extensive studies to devise additional mechanized systems which would efficiently and economically process the continuing workloads of the peacetime Army.[5]

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[4] *Ibid.*

[5] *Ibid.*

During the period from 1945 to 1956, the Army experienced a series of expansions and contractions as world-wide commitments of the country increased and decreased. New weapons systems were developed and, as a result of these and many other events, annual rentals for PCM rose to approximately $8 million by 1956.[6] Personnel costs and supplies increased this figure to about $32 million. The building and maintenance of a modern Army demanded immediate response from its data processing systems which could not be completely satisfied by a combination of manual and mechanical methods. The speed and accuracy required in such an environment, the tremendous task of translating masses of data into usable information for command decisions, and the need for real-time reporting of resources data to provide an instantaneous response to any requirement or state of readiness would have been highly impracticable without the electronic computer.[7]

In 1955, the Army installed its first automatic data processing equipment in the business area at the U. S. Army Signal Supply Agency, Philadelphia. The installation was followed in the same year by application of a computer to the military personnel accounting system in the Adjutant General's Office, Washington. In the non-business area (military operations,

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[6] _Ibid_.

[7] _Ibid_.

intelligence, research and development, and engineering) computers have been used since the early 1940's. Radar, atomic reactors, and other similar developments were the results of the explosive wartime requirements for scientific advancement.

In 1963, the Army's use of data processing equipment for business and non-business applications had 300 PCM installations and 116 ADP units, at a total cost of $133 million.[8]

In summary, the expansion of the Army, the advent of complex weapons systems, and the need for rapid communications resulted in the redesign of administrative and functional systems consistent with present-day requirements, made possible only with computers.

Department of the Navy

The following excerpts of testimony given by Edmund D. Dwyer, Chief of the Navy Management Office, before the House committee on electronic data processing, concisely sum up the Navy's brief history in the data processing field.[9]

World War II emphasized the military demands for scientific and engineering results requiring extensive and complex

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[8] *Ibid.*, p. 71.

[9] *Ibid.*, p. 115.

mathematical computations. This led to the first electromechanical and electronic digital computers designed for high-speed resolution of mathematical formulas. Central coordination or control procedures relative to acquisition and use of electronic computers have existed in the Navy since 1946.

A Mathematical Computer Advisory Council was established by the Office of Naval Research in 1946 to coordinate the development of Navy's scientific computer facilities. In 1952, its mission was expanded to include a review of equipment selection and justification documentation.

In 1954, the Navy installed the first large-scale computer for business applications at the Aviation Supply Office, Philadelphia. By 1955, the Navy had completed the installation of seven computers for scientific purposes.

The scope of the Navy ADP program for 1963 involved 159 punched-card installations, 213 computer units, of which 36 were Navy-owned, and 9,398 personnel engaged in the ADP program. The total operating cost of the Navy program was $95 million.[10]

Department of the Air Force

The following statement of Brigadier General L. B. Grossmith, Jr., Director of Data Automation, Headquarters, U. S.

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[10] *Ibid.*

Air Force, outlines the Air Force experience with data processing in the past several years.[11]

The Air Force has been a pioneer in the use of electronic data processing equipment (EDPE). In late 1948, Air Force funds were placed at the disposal of the Bureau of Standards to encourage and proceed with the development of electronic computers. As a result of that early interest a computer was installed in 1952 at Headquarters, USAF, for mobilization planning and similar computations.

Commencing with the installation of the initial computer in 1952, the Air Force has made wide and increasing use of EDPE. The current size of the EDPE inventory and its distribution among a wide variety of applications signify the reliance which the Air Force has placed upon the use of EDPE. Use of EDPE began during fiscal year 1956 on a significant scale, with 22 computers installed by the end of the year. The majority were used by the Air Materiel Command for logistics purposes.

During fiscal year 1958 and 1959, automation of the base supply function prompted another buildup of EDPE to satisfy the need for increased responsiveness accompanying the aerospace age. The size and complexity of the Air Force management problem has contributed significantly to computerization.

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[11] Ibid., p. 149.

The magnitude of the Air Force management problem can best be illustrated statistically. The asset value of all Air Force resources is estimated at $90 billion. Although this is indicative of the scope of the problem, such a general figure obscures the complexities relative to accounting, controlling and managing assets deployed at bases, depots, and other facilities throughout the world; for example: 1.9 million items for supply management valued at $12.8 billion; $6.5 billion value of engines; 15,600 aircraft in the inventory; and 1.2 million personnel as of March 31, 1963.[12]

At the end of 1963, the Air Force had 411 ADP organizational units, of which 159 possessed 328 computers, of which 37 were Air Force-owned. The total data processing equipment rental cost was $80 million during fiscal 1963; $21 million for punched-card accounting machines, and $59 million for computers.[13]

As the Air Force gained experience with EDPE, its use gradually evolved into an integral part of the Air Force management-operational process. Improved responsiveness for both operational and management needs and increased effectiveness and efficiency resulting from the use of EDPE increased the Air Force dependence on data automation.

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[12] _Ibid_., p. 150.

[13] _Ibid_.

Summary

In summary, it may be seen that much has happened in the past decade since automatic data processing equipment was first introduced in the Defense Department. Its rapid acceptance has had both fortunate and regrettable effects upon management responsibilities as will be shown later.

CHAPTER III

ORGANIZATION AND RESPONSIBILITY

Departmental Organization

The introduction of electronic data processing equipment into the Defense Department soon highlighted the need for a focal point for organizational responsibility and control.[1] Initial management techniques were developed within the Department of Defense by the Data Systems Policy Council established in 1957, several years after the first computers had been installed by the service departments. Up to that time authority for the installation of computers had been required by the Office of the Secretary of Defense. Since 1957, the responsibility for conducting feasibility studies, preparing specifications for consideration by manufacturers, establishing criteria for evaluation and justification of ADP proposals, and approving requests for electronic computer installations has been shifted to the Service Secretaries by the approval of military service regulations by the Office of the Secretary of Defense.

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[1] House Committee on Post Office and Civil Service, ADP Hearings, 1963, testimony of A. T. Bishop, Office of the Secretary of Defense, p. 16, *et passim*.

The Data Systems Policy Council was designated the Data Systems Review Division and placed in the Office of the Assistant Secretary of Defense (Comptroller) in 1958. The responsibilities for management of ADP programs within the Defense Department were later transferred to the Assistant Secretary of Defense (Installations and Logistics) in April, 1962.

These transfers of responsibility suggest that Buckingham's idea that "organization and procedure may have to be changed to fit the capabilities of the equipment"[2] may be relevant. The possibility that an Assistant Secretary of Defense for Automation may come into existence cannot be discounted.

The Army's data processing responsibilities devolve upon the Comptroller of the Army under the policy direction and guidance of the Assistant Secretary of the Army (Financial Management). The Comptroller of the Army is concurrently responsible to the Chief of Staff. The ADP functions of the Comptroller are performed by the Data Processing Systems Division, Office of the Director of Management.[3]

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[2] Walter Buckingham, Automation, Its Impact on Business and People (New York: Harper & Bros., 1961), p. 61.

[3] Department of the Army, The Army Program Manual (Washington, D. C.: U. S. Government Printing Office, 1963), p.2-1.

Complete authority to act for the Secretary of the Navy in all matters related to management and control of punched card and automatic data processing systems and equipment used in business administration, logistics, and engineering-scientific operations has been delegated to the Administrative Assistant to the Secretary of the Navy. He has been designated the Senior Policy Official for ADP in the Navy Department. The Chief of the Navy Management Office is assigned the responsibility of providing staff support and assistance to the Administrative Assistant in developing, coordinating, and evaluating plans and policy recommendations, preparing directives, disseminating information, providing technical advice, reviewing and evaluating progress, analyzing reports, and performing such functions as may be necessary to attain the program objectives.[4] Acting through the Office of the Chief of Naval Operations, the Headquarters, U. S. Marine Corps, and the bureaus and offices of the Navy Department, The Navy Management Office provides the staff assistance necessary to achieve an effective utilization and management of automatic data processing activities.

In contrast to the vertical chief of staff organizational structure of the Army's ADP chain of command, the Navy's

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[4] Department of the Navy, Navy Data Processing Program, Secretary of the Navy Instruction P10462.7, April 16, 1959.

hierarchial organizational structure seems likely to be less responsive in generating the feedback necessary for evaluation of systems effectiveness. The recent reorganization of four major bureaus of the Navy Department under the Chief of Navy Material may be a partial solution to this problem. The Navy Management Office providing assistance across the chain of command to both administrative and operational forces may precipitate additional organizational changes not now envisioned. As Buckingham has observed in his book on automation, "in many cases the introduction of automation opens the door to making a number of important changes in organization structure that were badly needed anyway."[5]

The acquisition and management of data processing equipment and related efforts are directed and monitored through the top management staff of the Department of the Air Force. The Assistant Secretary of the Air Force for Financial Management is the Senior Policy Official for the monitoring and reviewing of the development and maintenance of data processing support programs within the Department. The Director of Data Automation within the Comptroller Office monitors the acquisition process and manages ADP equipment in the Air Force.[6]

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[5] Buckingham, op. cit.

[6] Department of the Air Force, Report on the Inspection of Automatic Data Processing, (Washington, D. C.: Headquarters, U. S. Air Force, 1963), p. 3. Cited as ADP Inspection Report.

Local Organization

While the organization and responsibilities are reasonably well defined at the Defense and Department level, the problems of the military manager in the field are two-fold:

1. Where should the computer be in the organization?
2. What is the effect of the computer on the entire organizational structure?

The obvious answer to the first question is that the computer should be placed where it can be operated most effectively. Data processing equipment purchased for specific applications, such as, accounting functions, should be placed in the accounting division spaces. However, as the military departments gain more experience with data processing the advantages of a centrally located general purpose computer to provide services to several departments or divisions seem advantageous. The Department of the Air Force long-range plans call for one large computer on each of its major bases to provide data processing services to all tenant departments, activities, and units.[7] Smaller single-use computers will be used for logistics and payroll accounting in their division spaces.

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[7] *Ibid.*

The effect of the computer on the entire organization depends on the scope of its applications. Single-use machines are not nearly as disquieting as multipurpose equipment. The computer center tends to become a power center because it can be a source of immediate information for management use. Programmers and systems analysts become indispensable members of management's team as they are in on the organization's plans and goals from the inception to the realization.

Because of the computer center's operations involving several departments or divisions it should be located in the organization where it will be least disruptive to the smooth and efficient flow of business.

Centralization or Decentralization

Decentralization of the decision-making function is an extremely attractive objective in the military services. Commanders in the field can act swiftly and flexibly. Decentralization of decision-making responsibility has the further advantage of providing training, experience, and a testing ground for junior officers. The best way to develop qualities of responsibility, judgment, ingenuity, and leadership is to provide genuine opportunities for their exercise. The burden on the highest officials in government has precluded them from participating in all but the most highly important decision-making

in the past. But the advent of automatic data processing and efficient and reliable communications systems has weighed the scales in the opposite direction. Since the establishment of the Department of Defense in 1947, the following consolidated agencies have appeared upon the scene: the Defense Supply Agency; the Defense Communications Agency; the Defense Intelligence Agency; and the Defense Atomic Support Agency. This apparent centralization of functional efforts spurs the expectation of a Defense Personnel Agency, a Defense Research and Development Agency, and perhaps, a consolidation of the three services at some time in the future. The economic advantages of centralization are difficult to dispute in that operation of the whole should be considered over operation of a part. There may, however, be a point at which practical considerations force deviation from the most economical approach to the problem. The Comptroller General has expressed an opinion that central government direction is needed in management, procurement, utilization and planning of automatic data processing equipment.[8] This viewpoint appears tantamount to total centralized control, although not stated in so many words.

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[8] House Committee on Post Office and Civil Service, ADP Hearings, 1963, statement of Joseph Campbell, Comptroller General of the U. S., p. 9.

The Defense Department, joined by the House Subcommittees and other Federal agencies, opposed the central procurement provision by speaking out against the Brooks Bill, H. R. 5171,[9] which would have placed all procurement under the General Services Administration. The agencies which did not openly oppose the bill asked that they be "specifically excepted" from its provisions.[10]

Considerable duplication of effort would be obviated by the establishment of a central management organization to bring about exchange of information among agencies and between government and industry as pointed out by the Comptroller General's Report. Controversy exists as to where this management organization should be placed. The Comptroller would place this authority in the Executive Branch.[11] Centralized direction could

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[9] U. S. Congress, House, H. R. Bill 5171, 88th Cong., 1st Sess., op. cit.

[10] U. S. Congress, House, Committee on Post Office and Civil Service, Report on the Use of Electronic Data Processing Equipment in the Federal Government, Report No. 858, 88th Cong., 1st Sess., October 16, 1963, p. 12. Cited hereafter as House Committee on Post Office and Civil Service, ADP Use Report, 1963.

[11] U. S. Congress, House, Committee on Post Office and Civil Service, Hearings on the Use of Electronic Data Processing Equipment, 87th Cong., 2d Sess., October 2, 3, and 5, 1962, p. 9. Hereafter cited as House Committee on Post Office and Civil Service, ADP Hearings, 1962.

minimize the wasteful duplication of effort among the agencies by preventing repetitive explorations of the same or similar applications, some of which have already been developed. The skills of highly trained programmers would be employed most effectively by the consolidation of effort. Interdepartmental competition for skilled personnel would be greatly alleviated. Consolidation of efforts in the fields of personnel administration and disbursing alone could save thousands of dollars.

ADP Responsibilities

The Secretary of Defense recently revised the Defense Directive which assigns responsibility for the administration of automatic data processing equipment (ADPE).[12] Under this directive the Secretaries of the military departments and the directors of the agencies have the following responsibilities:

> 1. To designate a Senior ADP Policy Official to serve as the focal point for ADP policy and for administration of the ADP program within the military department or agency.
> 2. To develop and control programs for the design, improvement and standardization of automated systems along Department of Defense guidelines.
> 3. To be responsible for the management and operation of the ADPE installations within the military department or agency.

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[12] Department of Defense, Responsibilities for the Administration of Automatic Data Processing (ADP) Equipment Program, Directive No. 5100.40, September 28, 1963.

4. To perform continuing analysis and planning to insure effective and economical utilization of ADPE and related techniques.
5. To evaluate performance of automated systems.
6. To have maintained at a central point, current files of all ADPE and ADP systems applications.
7. To exercise approval authority for the selection of ADPE within the military department or agency.

While this directive provides general guidelines for the departments and agencies of the Defense Department, it is difficult to see how the desired objectives of eliminating unnecessary duplication and overlapping of effort, or of providing for the interchange of improved automatic data processing techniques, computer programs, and management procedures, can be achieved.

The directive seems permissive in nature, rather than regulatory as desired by the Comptroller General and the House Committee investigating the use of ADP in the Federal Government. Compliance by the individual departments would result in uniformity within that department, but not necessarily within the Defense Department. It is possible that additional implementing directives may have to be issued before effective cross-sharing of knowledge, systems, programs, and equipment becomes a reality.

While the Senior ADP Policy Official has approval authority for the selection and acquisition of ADP equipment in most cases, Department of Defense level of approval is needed in the following instances:

1. When waivers of competitive procurement are required (sole source procurement).
2. When changes in the peripheral gear of the electronic digital computers are indicated.
3. When changes in the central processor involve reprogramming.[13]

Thus, the responsibilities for the administration and procurement of automatic data processing equipment provide broad general guidelines for the military departments and agencies and are more permissive than restrictive in nature.

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[13] Department of Defense, Selection and Acquisition of Automatic Data Processing Equipment (ADPE), Directive No. 4105.55, September 28, 1963.

CHAPTER IV

PERSONNEL PROBLEMS

Personnel Management Survey

In 1959, an independent consulting organization conducted a survey into the personnel problems of the U. S. Government in the adoption and use of automatic data processing systems. They predicted the following five years ago with amazing insight into today's problems:[1]

> 1. The Federal Government will continue to be outbid on the labor market and will get little of the top competence emerging from the educational system, even though the spread in entry level pay between business and government appears to be less than sometimes supposed.
> 2. The balance of flow of experienced ADP people will be out of the Government rather than into it.
> 3. It will be progressively more difficult to recruit the native competence from within as the same adverse recruitment pattern at the intake stage which affects ADP affects the other occupational groups within the Government from which ADP personnel have been created in the past as well.

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[1] Lester B. Knight & Associates, Inc., Report of Survey of Personnel Problems of the U. S. Government in the Adoption and Use of Automatic Data Processing Systems, April 15, 1959, p. 11.

4. The problem will be more difficult to solve in relation to business applications than with respect to scientific applications.

a. Traditionally scientists have found more appeal in Government work than management oriented people.

b. Business applications are more difficult than scientific in the sense that a vast amount of detail has to be rationalized, whereas in the scientific field ADP is becoming an adjunct of professional practice.

c. The recruitment squeeze will be particularly acute at entry because Government will be in competition for a relatively small number of trained people. That is, while ADP will be offered in schools of business administration in the future, it is unlikely to be a popular subject.

5. Because all trends, particularly in the area of management and data processing uses, point to greater difficulties in developing effective applications, requirements for more sophistication and deeper grasp of management principles than ever before, success in the manpower field must be measured in qualitative terms even more than in quantitative terms.

6. The measures needed to solve or even ameliorate the ADP manpower problem will never be undertaken unless better mechanics for and much greater attention to long range manpower planning become available at a point of government-wide perspective and not merely departmentally.

Many of these predictions have indeed come to pass. One of the greatest handicaps today in systems development is the shortage of knowledgeable people in analysis and programming. Recruiting of high school graduates at the trainee level has not been difficult, but college graduates and journeymen are hard to find. Since training to acquire the necessary skills takes several years, programmers and systems analysts will probably

continue to be scarce as new equipment is added to the Defense Department inventory each year. Possibly, the most acceptable solution may be to retrain personnel whose primary skills are replaced by automation. This would accomplish the dual purpose of developing needed skills and solving the displaced worker problem.

Federal employee unions have voiced strong feelings in this matter regarding the Government's obligation to workers whose jobs are eliminated by evolving data processing methods.[2] Personnel found unsuitable for retraining would face resignation, retirement, relocation, or reduction in grade as the only other alternative. It is likely that the real impact of data processing automation may not be felt for several years after its introduction into business.

Losses to private industry of qualified programmers and administrators would tend to indicate that Defense Department installations are being used as training ground for industry. Both civilian and military personnel are being attracted by the higher paying jobs in industry.

The ratio of military to civilian employees working in automatic data processing is about two to one. Many military

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[2] House Committee on Post Office and Civil Service, ADP Use Report, 1963, p. 30.

computers are operated 24 hours a day, seven days a week. The remoteness of some work sites with the accompanying isolation and related lack of recreational and cultural facilities are strong deterrents to recruitment and retention of personnel. While military men may continue to man classified military equipment it is more appropriate for business-type machines to be run by civilian employees in order to release military personnel for operational duties. Thus, a shift in computer employees from predominantly military to civilian operators is envisioned as more qualified personnel become trained.

A related personnel problem involves the lack of government employees who are qualified to service and maintain government-owned equipment. Most equipment is maintained by service contracts with the manufacturers, whether leased or purchased outright. The manufacturers are under no obligation to continue these service agreements indefinitely and preparation should be made for the day when an in-house capability is required.

Maximum utilization of computer installations requires that they be operated on a two or three shift basis. Some considerations are due these personnel and their special problems must be resolved by management. Provision of fringe benefits, such as on-the-job training, cafeteria services, comfort conveniences, and the like, is essential in maintaining employee morale under working conditions outside of normal working hours.

These personnel problems, and other similar issues, have been under consideration by the House Committee on Post Office and Civil Service since 1959. In its latest report the following recommendations were presented for consideration and study by all levels of management in the Federal Government:[3]

> 1. In the continuation of efforts to relocate large groups of people affected by EDP automation, careful plans should be made to avoid the impact on the individual employee.
> 2. The effectiveness of the administrative machinery for transferring employees affected by EDP from one job to another should be reviewed.
> 3. The Civil Service Commission should establish a placement office to handle matters of persons displaced by EDP and other causes.
> 4. Management should provide thoroughly effective courses for retraining employees whose jobs are eliminated or otherwise seriously affected by EDP automation.
> 5. Attention should be directed to the higher degrees of skill being required in staffing electronic data processing systems and to the solution of future problems in this respect that may arise.
> 6. Management should develop plans, and maintain an alertness to opportunities, for advancing the careers of government employees in connection with the growing use of EDP systems.
> 7. Top management should directly participate in discussions of the effects of EDP automation on employees by personally visiting the sites of operations and conferring with the groups involved.
> 8. The policy of all Federal agencies should include a provision for equitable and reasonable advance notice (1 year or more) to employees concerning the anticipated effects of EDP automation on their jobs.

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[3] *Ibid.*, p. 6.

9. Studies on the probable effects of large-scale use of optical scanners on Government employees should be continued, and reports of the findings should be prepared by the Civil Service Commission.

The subcommittee found that opinions differ considerably about the adverse effects of electronic data processing automation on Government employees, and about the urgency of the problems and situations.[4] The U. S. Civil Service Commission has said that "remarkedly little unemployment has been created in the Federal Government by automation." The Commission has deduced from the hearings and its experience that "persons separated by reduction-in-force due to automation can comprise only an extremely small fraction of the total."[5]

Conversely, the National Federation of Federal Employees, through the testimony of its president, considers "automation to be one of the disturbing causes of national unemployment."[6] He expressed the belief that the effect of EDP automation on Government employees is so serious that consideration should be given, among other things, to a moratorium on all procurement of electronic data processing systems by the Government, except for defense purposes, until the unemployment situation improves.

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[4] _Ibid_., p. 30.

[5] _Ibid_.

[6] _Ibid_.

In October, 1962, the Civil Service Commission listed the means that were already in use by Federal agencies to soften the impact of data processing on employees whose jobs were adversely affected. They include the following:

> a. Putting attrition plans and no hiring injunctions into effect well in advance of changeover.
> b. Providing full information as early as possible to employees so they will know how the plan affects them.
> c. Make temporary appointments and details to avoid increasing permanent staff and to save jobs for affected employees.
> d. Training to equip employees for reassignment to other jobs.
> e. Transfer and relocate employees at Government expense.
> f. Giving up to 6 months' advance notice to employees whose jobs are affected.
> g. Widely distribute qualifications and history statements of affected employees as part of a comprehensive outplacement program.
> h. Special personnel procedures such as waiver of qualification requirements; temporary appointments and details in excess of 1 year; temporary appointments of former employees; temporary promotions; and discontinued service retirement for eligible employees whose jobs are to be abolished.[7]

While it appears that the Civil Service Commission has been actively attempting to protect the rights of government employees, the benevolent image has apparently not penetrated through to those outside of government as this statement by the Lester B. Knight Associates' survey would indicate.[8]

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[7] Ibid., p. 33.

[8] Lester B. Knight & Associates, Inc., op. cit., p. 12.

> The most disquieting testimony encountered during this study was that field establishments find difficulty recruiting young people not only because of lower entry level pay, but also because "they don't want to get involved with the Government." Therefore, an extensive and authoritative review is recommended of all Federal personnel policies and practices conceivably contributing to this attitude to see if they cannot be modernized and liberalized.

The subject of automatic data processing manpower and personnel practices is broad. Practices are still fluid, and real understanding and familiarity with the art are limited. Continued open-minded inquiry and imaginative innovation of the highest order, on the part of all levels of government management, will be needed for a long time to come, if the government is to realize the full potentialities of data processing. Many of the personnel problems in this area permit no easy or immediate solution, but will require thoughtful effort and attention over a considerable period of time.

The most comprehensive study to date was performed for the Bureau of the Budget, and it is believed that its findings will have value as reference use for those who are immediately involved with ADP manpower, or who will be in the future.[9] Accordingly the following conclusions and recommendations as to overall ADP manpower and personnel practices and policies are

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[9] *Ibid*., p. 13.

presented for consideration of this vital management resource:

1. It is recommended that more complete statistics about Government employment and requirements for ADP manpower and salary rates for ADP be maintained centrally on a regular basis. It is of interest that total facts about ADP manpower in the Government were unknown previously and that all published studies about ADP salaries available at the inception of this study (1959) came from outside sources even though the Government is the largest employer of such personnel and the principal publisher of statistics about non-governmental manpower.

2. A review of grade levels of ADP Administrators of certain installations and applications is recommended. The job grading process, which is generally oriented if not by conscious policy at the center, at least by the sum of the actions taken at the periphery, to keeping down the Government wage bill and the great mass of employees happy by keeping all occupations more or less "in line" salary-wise, should not be allowed to stifle new professions. That some ADP administrator jobs are graded vulnerably low is attested by the fact that there was only one job reported above Grade 15, and the median grade was Grade 13.

3. It is recommended that the Federal Inter-Agency Committee on ADP should create a standing subcommittee which would keep abreast of developments relating to ADP manpower and personnel problems and report periodically to the full committee. Its terms of reference should cover the full range of personnel problems including:

Manpower Statistics
Job Engineering
Job Standards
Recruiting and Testing Devices
Combatting Turnover
Technological Unemployment Caused by ADP
Management Indoctrination
Clarification of Training Content
Intra-Governmental Training Facilities
Use of Extra-Governmental Training Sources

4. It is recommended that more conscious and adequate account be taken of key "associated" ADP occupations--especially, mathematicians--in planning manpower and training requirements.

5. It is recommended that the organization and operation of ADP units be studied from an efficiency viewpoint to see if manpower requirements cannot be reduced by introduction of better methods, as has been done in the case of some electric accounting machine (EAM) installations through the years.

6. It is recommended that there be developed an equivalent for a "wage board" approach in setting salaries for this new and fluid field. The purpose of this approach would be to recognize that a new discrete field of this kind is a universe unto itself which should not be subjected to the rigidity of the grade system and for which pay should be based on the "market rate." Moreover, it is necessary to be realistic about the national character of the labor market for these occupations, especially for higher level jobs. Hence, the "market" to be considered in making a determination of the "going rate" should be nationwide and not local.

7. The relationships between the pay scales of management analyst (digital computer) and programmer should be reviewed in the light of more definitive job engineering which needs to be developed to make sure one is not over-priced in comparison to the other. Data assembled indicated that this is a substantial "gray" area.

8. Re-appraise forecasts of manpower requirements for ADP at a responsible level of each agency semi-annually for the next few years making sure that they are carefully related to plans for acquisition of equipment, solid but imaginative projections of new type of applications and take adequate account of attrition. Also make sure that such manpower projections are made in the light of an informed understanding of the possible effects of new trends in the equipment and methods of programming and operating (i.e., the capabilities of the next generation computers, use of autocoding and compilers, optical scanners, etc.).

9. Central agencies and departmental levels of Government should take more initiative on ADP manpower problems and personnel practices to provide more coordination, better leadership, and in general to bring the amount of higher level management attention paid to ADP personnel matters more in line with that paid to ADP equipment acquisition and details of ADP applications.

10. Carry on experimentation in highly technical fields of research at a central point at which all the resources of the Government can be mobilized and make the results available to the rest of the Government when new devices and developments have been validated. Some important areas in which such experimentation is recommended include:

a. Program research in the area of business data processing which delves beneath the surface of the specifics of routines and seeks to identify the elements of systems design and principles of programming approach which makes one program better than another. This should be attacked systematically on a Governmentwide basis by the best skills that can be mobilized as a matter of highest priority.

b. Finding a better means of communication between the systems analyst and the programmer.

c. Development of techniques adapted to the field of ADP for successfully assaying the traits of temperament and personality which influence success perhaps as greatly as basic intelligence.

d. Development of better devices for testing for ADP aptitude and basic intelligence for these occupations.

11. The Government should be prepared to participate officially and more formally than in the past in joint research efforts with outside groups relative to selection and training of ADP personnel as well as on problems of machine design and application.

12. The Government should be prepared to underwrite necessary research and experimentation by outside organizations in subject fields where it lacks the trained resources within the Government in relation to personnel as well as computer use problems. This approach should naturally be on a coordinated overall Government basis and carefully administered so that it does not become an encouragement to other interested parties to leave everything to Government initiative. Properly used, this technique can lead to the solution of some problems more expeditiously and even more economically than direct Government action.

13. The manpower aspect has, generally speaking, been taken for granted too readily in the past. In planning future ADP installations, it is recommended that the following be given greater consideration:

a. The relative labor market and manpower advantages of alternative locations should be considered in activating new installations.

b. The rapid increase in the number of computers in Government may have been too fast. From the standpoint of the entire Government and the individual departments, the rate of adoptions should in the future be controlled and tempered to considerations of good manpower management Government-wide.

c. To a much greater extent the details of an application should take account of the human factor--the ability to find or to train people to operate in a certain manner. Today there are to be found "people limited" systems which have been expediently designed to the capabilities of the programmers and operators available in a locality rather than the real needs of the application.

The reverse is also true--there are "system frustrated" people attempting to do a job on applications where the systems were designed without regard to recruitment and training considerations and abilities and traits of temperament of human beings.

d. Installations in the future should be scheduled on the basis of the relative "computer readiness" of the organization concerned. In gauging "computer readiness" management sophistication with the general principles of scientific management as well as indoctrination in ADP should be considered, as well as strength of the systems staff and systems tradition, quality of manual and EAM systems, general management "tone" of the organization, etc.

14. Long-range planning for ADP manpower--i.e., in terms of 5 years and 10 years, should be undertaken as a matter of even greater urgency than short range planning and it is equally essential that it be done on an overall basis.

In the rapid growth of electronic data processing technology, both inside and outside of Government, too much emphasis has been placed on equipment and gadgetry and not nearly

enough on the man in the man-machine ratio. Looking ahead into EDP's future, this failure to give adequate attention to the human aspects of the art could seriously jeopardize full realization of EDP's promising potential. Already, in spite of the high cost of EDP equipment, personnel costs make up about one-half of the total cost of a system.[10] In the years ahead, as speeds increase and machine costs tend to decrease, personnel costs are likely to increase percentagewise. Machine technology has progressed beyond the ability of people to use it. The technological gap can only be closed by increased recognition of the people in EDP systems and by increased attention of management to EDP personnel issues and problems.

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[10] House Committee on Post Office and Civil Service, ADP Inventory, 1963, p. 8.

CHAPTER V

PROCUREMENT PROBLEMS

Purchase Versus Lease

The subject of purchase versus lease of electronic data processing equipment, while always an important decision to be made by managers, has received emphasis during recent months in the Congress and by the General Accounting Office.[1] No firm policy guidance for the Executive Branch of the Government existed until 1961, when the Bureau of the Budget published Circular A-54.[2]

In October, 1962, hearings were held in the House of Representatives in which the question of purchase versus rental was discussed by officials of various Government agencies. Most reported that purchase of electric computing equipment was planned in the future or that a decision would be made at a later date.[3]

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[1] U. S. General Accounting Office, Study of Financial Advantages of Purchasing over Leasing of Electronic Data Processing Equipment in the Federal Government, March 6, 1963. Hereafter cited as GAO study.

[2] Bureau of the Budget, Policies on the Selection and Acquisition of Automatic Data Processing (ADP) Equipment, Circular A-54, October 14, 1961.

[3] House Committee on Post Office and Civil Service, ADP Use Report, 1963, p. 43, et. passim.

In March, 1963, the Comptroller General sent a report to Congress in which he recommended the establishment of an office in the Executive Branch to make possible government-wide decisions on the financial advantages of purchasing and to assure more complete utilization of equipment.[4] By the end of fiscal year 1963, about 15 percent of the computers installed in Federal agencies had been purchased.[5]

Most commercially available automatic data processing equipment can be acquired by purchase or lease, with or without an option to purchase. The General Services Administration has contracts with the principal manufacturers, listed in the Federal Supply Schedule, for the rental or purchase of data processing equipment. The contracts for purchase were not added to the Federal Supply Schedule until after the Bureau of the Budget had published Circular A-54.

The most common method of purchase since the introduction of automatic data processing equipment has been by the lease method for several reasons. The large initial outlay of capital has been one factor. Also, the machines produced by the largest manufacturer could not be purchased for several years after the introduction of automatic data processing equipment on the market.

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[4] GAO study, op. cit.

[5] House Committee on Post Office and Civil Service, ADP Inventory, 1963, p. 12.

One of the advantages of renting equipment is that the large capital expenditure can be spread over several years and not distort the budget for any one year. Rapid technological progress has been made in the computer industry, thereby relegating first generation machines into obsolescence long before they are worn out. Program changes which may occur might decrease computer utilization or eliminate the need for the installation or base, thereby making leasing attractive.

On the other hand, the major objection to leasing is that rental costs may exceed purchase costs if the equipment is leased for four or more years, as shown by Bureau of the Budget Circular A-54.[6]

Most equipment has no trade-in value after seven years, according to a General Electric Computer Sales Representative.[7]

As computer technology progresses manufacturers have reduced the purchase price on earlier models, thereby changing the basis upon which the purchase versus lease decision was based. Martin Hochdorf, Chief of the Computing Center, Tennessee Valley Authority, concludes:

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[6] Bureau of the Budget, Circular A-54, op. cit.

[7] Personal interview with William H. McHugh, General Electric Company, New York Area Office, April 30, 1964.

> The critical questions on which a manager should satisfy himself in order to reach a decision on purchase versus rental of computing equipment are--
>
> 1. Results of the basic economic analysis;
> 2. His estimate of the quality of continuing maintenance of the equipment and continuity of other services by the manufacturer; and
> 3. His evaluation of the management hazards of a changing climate or changing environment.
>
> If he is satisfied on these scores, he should then ask himself whether the manufacturer or the Government should reap the financial advantages resulting from continuing operation. It becomes a matter of who will undertake the financing. If financing is available to the customer and long-term computer utilization and profitability from such use appear probable, then he should by all means take the plunge. The rewards are very attractive.[8]

Costs

To provide a background for the magnitude of the funds involved the following information is abstracted from the most recent inventory of automatic data processing equipment prepared by the Bureau of the Budget.[9]

The total costs for automatic data processing in the Federal Government was $705 million in fiscal year 1963. The Defense Department alone spent $447 million, or two-thirds of the total. These costs include the salaries of personnel, equipment

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[8] Martin Hochdorf, "Purchase or Rent a Computer?", a report addressed to the Interagency Committee on Automatic Data Processing, Washington, D. C., April 26, 1963.

[9] House Committee on Post Office and Civil Service, ADP Inventory, 1963, pp. 4-12.

rentals, supplies, equipment purchase and maintenance, site preparation and contractural services. The figures broken down by services are as follows:

Air Force	$179 million
Army	133 million
Navy	94 million
Office of SECDEF	41 million
	$447 million

The Defense Department has already identified almost 200 computers which meet the criteria for purchase at a cost of $157 million. An additional $47 million worth of punched-card equipment has been identified for purchase. The decisions on funding these purchases have been delayed pending availability of additional funds over and above budgeted estimates for 1964. It appears likely that future procurement policies will tend away from leasing and more toward purchasing.

An additional method which might be explored is purchase of equipment on the American installment plan so widely used in business. Periodic payments could be made to the manufacturer, and the title would pass to the Government after the prescribed number of years. Manufacturers would probably find this method almost as favorable as leasing in that it would spread their income over several years instead of the year of purchase.

Summary

Managers who believe their organizations have a proven need for automatic data processing equipment, but who lack funds either for purchase or lease, should investigate the possibility of sharing equipment with other government agencies in the local area. A pilot project on sharing of federally-owned equipment in the Philadelphia area is now under study to determine its feasibility. Both the Bureau of the Budget and the General Accounting Office are monitoring the results of the attempt to obtain increased utilization of this high cost equipment.[10] At the present time equipment sharing remains optional at the discretion of the individual departments. Defense policies provide for the maximum utilization and sharing of installed automatic data processing equipment. Utilization figures collected by the military services and defense agencies indicate that most computers are being utilized on a two-shift basis. Many are operating on a three-shift basis and cannot take advantage of the mobilization expansion capabilities which computers provide.[11]

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[10] House Committee on Post Office and Civil Service, ADP Hearings, 1962, p. 21.

[11] House Committee on Post Office and Civil Service, ADP Hearings, 1963, extracted from testimony of A. T. Bishop, Office of the Secretary of Defense, p. 27.

According to the latest report of the House investigating committee, there still remains a predilection to rent and lease computers even when the arithmetic clearly indicates they should be purchased. There are several reasons for this rental fixation, but primarily it is because

> 1. The annual budgetary and congressional appropriations system favors the smaller rental figures as against the larger purchase items;
> 2. There has been a notable and understandable reluctance on the part of some suppliers to sell their equipment and suppliers pricing policies tend to encourage rentals;
> 3. Some agencies, especially those poorly equipped technically to manage an ADP system, have been reluctant to purchase, preferring to turn most of their computer management over to the supplier along with a rental contract; and
> 4. In other cases, agencies have hesitated to purchase fearing that their commitment may later prove to have been short-sighted.[12]

It may be seen that there is no easy or correct solution of the purchase or rent dilemma. The facts should be studied in each individual case and the decision reached should be the most economical of the alternatives available.

Walter Buckingham's candid views on the subject of whether to purchase or rent a computer may fairly well describe the situation.

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[12] House Committee on Post Office and Civil Service, ADP Use Report, 1963, p. 14.

> Equipment leasing is something like free love--both have cost advantages over ownership or marriage; both involve relationships that may be terminated fairly easily; both are subject to legal difficulties not found in the conventional arrangement; both are probably more talked about than practiced.[13]

Contract Negotiations

The Comptroller General reports showed that overpayments of hundreds of thousands of dollars were made by agencies because of failure to understand and properly administer contract provisions that are used in determining rental payments.[14] In some instances, poor record keeping procedures for recording equipment utilization information had led to overpayment. In a recent examination at the National Aeronautics and Space Administration's Goddard Space Flight Center, it was estimated that approximately $1.2 million had been overpaid on the rental of ADP equipment.[15] Steps are now being taken by the agency to recover this overpayment.

Contract administration will probably continue to be the subject for General Accounting Office reports. Management must

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[13] Buckingham, op. cit., p. 73.

[14] House Committee on Post Office and Civil Service, ADP Hearings, 1963, p. 7.

[15] Ibid.

exert considerable effort to correct the mistakes unearthed by the examinations of previous unsatisfactory and uneconomical procedures.

The Department of Defense has taken a step toward the joint administration of contract negotiations within the Department. The following list represents some of the significantly improved terms that have been obtained through contract negotiating management since 1956:

1. Rental contracts for ADP were placed on a "use" rather than an "availability" basis. Under the use concept, no extra shift rental is paid until the equipment is actually used 176 hours a month.
2. A standard of performance was developed requiring that the equipment perform fully and properly at a ninety per cent effectiveness level for 30 consecutive days before rental would be paid.
3. Liquidated damages were included for failure to install the equipment by the specified installation date, and to deliver programming aids by an agreed upon date.
4. A system could be discontinued upon 90 days' notice and an individual machine on 30 days' notice.
5. The amount of program testing time was increased.
6. Requirements for programming aids without extra charge were added.
7. Terms and conditions were negotiated for the purchase and maintenance of equipment.[16]

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[16] Department of the Air Force, ADP Inspection Report, p. 20.

During fiscal year 1964, it is hoped that additional improved terms and conditions can be negotiated with the manufacturers. Some of the items deemed desirable are:

1. Government to reserve the right to use time meters.
2. Increased use periods, limited use, discount options, and reduced rental for outmoded systems.
3. Credit for nonoperative machines to be allowed after 12 hours instead of 24.
4. Mechanical replacement if the amount of downtime exceeds ten per cent of operational use time in two consecutive months.
5. Contractor-sponsored changes in site preparation causing delay to be subject to liquidated damages.
6. Reduction in rental charges when manufacturer reduces purchase prices.[17]

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[17] *Ibid.*, p. 21.

CHAPTER VI

AUTOMATIC DATA PROCESSING SYSTEMS

Advantages

The advantages of automatic data processing systems are easy enough to state, but sometimes hard to accomplish. This attractive list of advantages has to a large extent been responsible for the original overenthusiasm of prospective users. Some of the major advantages are:

1. Speed.
2. Accuracy.
3. Greater control.
4. Small external storage.
5. Decision-making ability.
6. Internally stored program.

The speed of computers over manual or mechanical methods is practically unquestioned. Many thousands of calculations can be performed each second, and masses of data can be processed or rearranged for reports in a fraction of the time required by other methods.

Accuracy is a feature which is of great importance in automatic data processing. Computers offer an accuracy for each unit of work that cannot be matched by other means.

Greater processing control is facilitated as data need be introduced into the processor only once, and then handled automatically. This prevents misplaced files or lost cards in transit between machines.

External storage space requirements are reduced to a minimum as information can be recorded with accuracy and permanence on magnetic tapes, which generally form the major media for mass data storage in an electronic system.

The decision-making capability of a computer is one of the most important benefits to be derived from its use, but rarely is this feature used to its maximum potential. The electronic data processor has the ability through programming to make the necessary decisions to select one course of action or another depending upon given criteria at any multidirectional point in a program.

Lastly, the advantage of having an internally stored program is that the program itself is capable of being modified in the same manner as the data that is to be processed. This ability to modify an existing program to effectively produce a new program enables the number of steps to be reduced and provides

a tool of great flexibility.

This discussion of the advantages of automatic data processing has been briefly and concisely stated for comparison purposes. Equipment manufacturers, computer salesmen, company brochures, trade publications, and technical journals extol the merits of office automation, but rarely are the disadvantages mentioned. Since the emerging management issues of data processing installations converge upon the problem areas, an examination of the disadvantages seems in order at this time.

Disadvantages

The disadvantages of automatic data processing systems include at least the following:

1. High cost of equipment.
2. Cost and difficulty of programming.
3. Channeling of work.
4. Conversion problems.
5. Training of personnel.
6. Organizational problems.
7. Management problems.
8. Morale problems.

The cost of installing and operating an automatic data processing system is of primary importance. For example, for a

large-scale computer the average start-up costs were $800,000 and the average annual operating costs were $750,000.[1] Most usable systems with a central processor and sufficient input and output equipment to handle the required data now have rentals of from $100,000 to $500,000 annually.[2] This represents a very large investment for management and offers only a theoretical prospect of return, and that only after a considerable number of man-years spent in analysis, planning, coding, conversion, and the running of parallel operations.

Programming, which includes the original analysis of the problem, the planning for a solution, the encoding of these solutions to machine language, and assuring accuracy and correctness, may take many years of effort. The major difficulty of programming is to foresee every possible exception to any given routine and to allow the computer to take appropriate action. This forces an incredibly thorough scrutiny of the operations and sends the time and cost of programming soaring.

Since the organization's information has to be channelled through one piece of equipment, this causes many machine scheduling problems. It is necessary to plan ahead carefully,

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[1] Business Week, June 21, 1958, op. cit., p. 6.

[2] Victor Lazzaro (ed.), Systems and Procedures (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1959), p. 338.

to allow specific times for each of the operations that have to be performed, and to establish priorities in the event of a breakdown. Few companies have the luxury of stand-by equipment, and alternative means of processing have to be arranged.

Conversion problems pose a twofold problem. Site preparation costs for air conditioning, adequate power supply, sufficient space, and hardstand preparation for the equipment can amount to $200,000 in some large installations.[3] In addition, at its inception there is usually a need to run parallel operations to ensure the accuracy of the new processing methods, thus creating a need for extra space. The second major item involves the conversion of source documents, records, etc., to media suitable for electronic data processing usually involving a large amount of keypunch work. A related conversion problem is that of forms design which can greatly simplify the editing requirements of the electronic system.

Training of personnel in programming and operating the computer, on the average, requires from three to six months, depending upon the size and type of computer. The formal technical training in programming furnished by the manufacturer usually requires about half of this period. Considerably more time is

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[3] _Ibid_.

needed to train systems analysts, management analysts, and electronics technicians for their vital roles in the organization. A recent data processing publication suggests that a two-year post high school curriculum would be reasonably adequate in training computer programmers and business application specialists.[4] Thus, the training of required personnel could conceivably take from three months up to two years to develop.

The impact of a computer upon the organizational structure can be significant. The studies of a systems analyst should determine what consolidation of work units or other even more fundamental organization changes will be needed to fully realize those benefits that are being sought as justification for acquiring a computer. Division managers have fought effective delaying actions in the past as they have seen people, equipment, and elements of expense taken out from under their line authority as the conversion process got under way.[5] There can be unusual resistance to change in many organizations.

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[4] U. S. Department of Health, Education, and Welfare, Electronic Data Processing-I, Technical Education Publication No. 4 (Washington, D. C.: U. S. Government Printing Office, 1963), p. 1.

[5] Richard F. Neuschel, Management by System (New York: McGraw-Hill, 1960), p. 270.

Coordination of the change in machines, men, and methods will require a high order of administrative and management ability, based upon an understanding of the interrelationship of various aspects of management planning and control, electronic systems, and integrated information systems. The evaluation of these newer tools depends upon the ability of the executives to develop certain conceptual skills. These skills include the ability to see the enterprise as a whole, to know whether objectives are mutually compatible and valid, to recognize how various functions of the organization depend upon one another, to determine which assumptions must be made in order to allocate resources in an optimal manner, to recognize various alternative courses of action and their potential results, and so on.[6] The development of enlightened management takes considerably longer than any of the educational problems associated with automatic data processing.

Finally, the installation of a computer produces mixed emotions on the part of the workforce. People are usually for the installation as long as it does not affect them personally. Eventually some reduction of the clerical force takes place, which naturally has an adverse effect on morale. The person who

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[6] George Kozmetsky and Paul Kircher, Electronic Computers and Management Control (New York: McGraw-Hill, 1956), p. 127.

feels that he will lose his job or status is not likely to cooperate in making the computer installation a success.

Unfortunately, the disadvantages of electronic data processing are numerous, and they have been slurred over or underestimated by potential users. Perhaps these features should more properly be called limitations. Management myths about automation have arisen as a result of the view that automatic data processing is nothing more than the sum of specific equipment, but automation is much more than this. It is a new concept complete with a whole new set of principles. For some firms electronic computers have performed wonders; for others, they have nearly caused disaster.[7] Everything depends on how thoughtfully the equipment is used. But a rethinking of the organization's whole operation is necessary to define goals clearly, estimate costs realistically, and accurately assess what new functions data processing can perform. Only then can management weigh the probable advantages against the possible disadvantages of an automatic data processing installation.

Feasibility Study

The success or failure of an automatic data processing installation depends, to a large extent, upon the adequacy of the

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[7] Buckingham, op. cit., p. 43.

feasibility study which preceded the installation. The close and careful analysis of the systems and procedures in use in an organization is a prerequisite for any management action. Richard F. Neuschel, Director of McKinsey & Company, pointed out these critical conditions and attitudes as being the major barriers to success:[8]

> 1. Lack of top-management understanding.
> 2. The illusion that administrative costs are controlled through budgets.
> 3. The hidden character of procedures improvement opportunities.
> 4. Lack of hard-headed profit consciousness among most of the managers of functional segments of a business.
> 5. The desire for protection among supervisors of paper-work activities.
> 6. Failure to tackle procedures improvements projects in a broad-guaged, fundamental way.

The great majority of business computer applications throughout the country are nothing more than the electronic automation of what was done in the past under essentially the same organization arrangement that existed in the past. The result is that the number and magnitude of the benefits realized have, in many instances, been disappointing.

Much of the work done to date in making electronic data processing feasibility studies has been superficial and faulty, and, as a consequence, has led to unsound decisions.

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[8] Neuschel, op. cit., p. 29.

An analytical approach to the electronics feasibility study should determine what the true objectives of the organization are, and how ready the organization is for fundamental changes in its data-processing activities. Next, a determination should be made whether the use of an electronic computer of any size seems sufficiently attractive to warrant the effort and expense of a detailed study, and what appear to be the most promising applications. A decision in the affirmative at this point provides the basis for a detailed study to determine whether to install a computer now or at some future time, and the size and make of hardware, if a decision should be reached to proceed with the acquisition and installation of a computer. The General Services Administration makes available to all agencies and departments of the Federal Government its ADP Project Management Handbook and ADP Equipment Management Handbook for guidance and use in making feasibility studies outlined above.

As the key step in determining whether the proposed electronic data processing installation will save clerical costs, the feasibility study group must estimate as accurately as possible (1) the nonrecurring equipment-acquisition, installation, and data conversion costs, and (2) the annually recurring operating costs. The McKinsey studies have shown that there is a tendency to underestimate one-time changeover costs and

recurring operating costs in most cases.[9]

As an example, the Army's Transportation Command, St. Louis, spent $300,000 for site preparation and $360,000 for rental of equipment which was grossly inadequate after only two years of operation.[10] Only after the costly procurement of new equipment was the situation improved. Expert feasibility and proper advance planning would have shown the inadequacy of the equipment selected before it was too late.

Frequently the greatest economies of automation can be attained only if the system of organization and procedure are changed to fit the capabilities of the equipment. Thus, machinery should not necessarily be designed to perform tasks already being done, but the whole system of tasks may have to be altered to make use of the equipment. Related to this is an interesting fact. Many agencies that have taken the revolutionary step of redesigning their management organization and procedures have discovered that if the same amount of creative thought was applied to their old operation, irrespective of automation, a lot of economies could be achieved without the new equipment.[11]

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[9] *Ibid.*, p. 266.

[10] House Committee on Post Office and Civil Service, *ADP Hearings,* 1963, p. 6.

[11] Buckingham, *op. cit.*, p. 61.

The feasibility study does not provide a quick, easy path to achieving optimum use of a computer in business operations. Nor will the acquisition of a computer enable management to avoid any difficult problems that it was not willing to face squarely in the past. Clearly those who profit most from electronic data processing will be those who have the courage to apply an exacting, fundamental point of view to the question of whether or not to use the equipment at all.

Date Processing and National Defense

No discussion of data processing or technological progress could be complete without a discussion of its impact on the national defense posture of the country, for it is here that technological advances have the greatest influence. The cost of national security has now risen to the point where it is not only a major factor in the national economy, but is a drain on our national resources as well. Defense money comprises over half of the national budget. The Congress has authorized expenditures in excess of $55.4 billion for fiscal year 1964 for Defense out of a total Federal administrative budget amounting to $98.9 billion.[12] The defense program budgeted for is stated in terms of a minimum

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[12] Bureau of the Budget, The Budget in Brief, Fiscal 1964. (Washington, D. C.: U. S. Government Printing Office, 1964), p. 9.

acceptable defense program and not that program which would be desirable if unlimited funds and resources were available. From the point of these costs alone, a serious national problem exists, particularly when it is considered that future expenditures will probably tend to increase. Military and civilian managers in the Defense will be faced with continuing pressures for improving efficiency and decreasing costs at every opportunity.

What about this enormous expenditure? How does it affect our national well-being and what has this to do with data processing? With an annual expenditure of public funds for defense which is approximating ten percent of the Gross National Product (GNP), there is a real problem of limiting these expenditures in terms of what is best for the national economy. Some authorities suggest that it is feasible to commit as much as 16 percent of the growing GNP to national defense. However, in a decade when it is a national objective to increase the growth rate of the GNP, can this rate of expenditure for defense be tolerated when something over half of the budget is non-productive and adds nothing at all to the nation's economic progress?[13] Similarly, with the costs of an individual weapons system in mind,

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[13] Goals for Americans, A Report of the President's Commission on National Goals (New York: The American Assembly of Columbia University, 1960), p. 10.

how can we be sure that it is the one that will give the greatest effectiveness for the dollars spent?

One safeguard is that proposed by Hitch and McKeen and is the one currently being used in the Defense Department.[14] The method is based on computer analysis of all the variables in a weapons system, including procurement cost, availability and effectiveness in comparison with other alternative weapons. Although the system contains "incommensurables,"[15] it is receiving the full time and attention of the Defense Department and gives promise of being an invaluable aid in making the major decisions on weapons systems in the future.

The important thing is that we now have a defense problem in terms of costs to the national well-being that is so tremendous in proportions and so complex in its ramifications that only an automated decision-making process is capable of considering the variables involved and properly determining their interrelationship and relative effectiveness.

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[14] Charles J. Hitch and Roland N. McKeen, The Economics of Defense in the Nuclear Age (Cambridge: Harvard University Press, 1960), p. 182, et. passim.

[15] Ibid. Incommensurables as defined by Hitch and McKeen are "certain consequences that cannot readily be translated into the common denominator or denominators that are being used."

CHAPTER VII

CONCLUSIONS

The following conclusions and recommendations are drawn from the information presented in this paper as supplemented by the latest House hearings on the subject of electronic data processing in the Federal Government.[1] These conclusions are:

> Department of Defense organizational arrangements for EDP systems are not universally adequate or suitable to the tasks to be performed and the problems to be solved.
>
> Machine technology has progressed beyond the ability of people to use it. The technological gap should be closed by giving increased recognition to the people in the EDP system, by increased attention of top management to EDP matters, and by accleration of automatic programming development.
>
> The principal problem of staffing EDP systems is in the area of programmers. There is lack of communication as to the seriousness of this problem. The sources of supply are insufficient to the needs, and new and improved sources should be developed.
>
> Problems may become aggravated in the area of recruiting engineering maintenance personnel, and action should be taken to anticipate them. There is a need also to improve working conditions of employees on extra-hour shifts.
>
> While Federal Government agencies have demonstrated considerable ability to control adverse effects of EDP automation on employees, the future is not assured. Therefore, there should be no letdown in existing efforts to reduce EDP's impact on Government employees, and constructive actions should be taken.

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[1] House Committee on Post Office and Civil Service, ADP Use Report, 1963, p. 4. et. seq.

> A comprehensive statistical reporting system covering electronic data processing systems activities of the Federal Government does not exist and should be established. The system should include a means of evaluating EDP systems accomplishments for individual departments and agencies and for the Government as a whole.
>
> There are widespread differences of opinion as to whether it is advantageous to purchase or lease EDP systems, and the causes of the dilemma should be determined. Meanwhile, complete objectivity should be practiced and the best judgment exercised in making evaluations and in arriving at EDP purchase versus lease decisions. The interests of the Federal Government as a whole should be considered.
>
> EDP systems by custom are procured via negotiated contracts and a limited number of plans. A more competitive system and new plans of procurement should be explored.
>
> Standardization of electronic data processing systems is vital to the efficient and expeditious use of the systems by the Federal Government, and a serious need exists for a dynamic standardization program.

Recommendations

The following sixteen recommendations of the House Committee, based upon its four years of investigation and hearings, have been selected by the author as those which bear directly on the issues discussed in this paper, and are noteworthy for further implementation and exploration:[2]

> 1. The Defense Department should carry out a program of continuous evaluation and review of its electronic data processing systems management similar to reviews made by the General Accounting Office.

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[2] *Ibid*.

2. In the development and application of management and other systems to electronic data processing equipment, efforts should be coordinated and information disseminated to avoid overlap and duplication, and to promote maximum progress and standardization.
3. There should be increased recognition that electronic data processing is a system in which people rank equally with machines as part of the system. More emphasis, therefore, should be placed on the human factors in research, development, management, training, and all other divisions of EDP effort.
4. Top management should become thoroughly familiar with electronic data processing for purposes of exploiting more fully the capabilities of EDP technology and to assure the adequacy of long-range planning and the development of integrated systems. This includes continued close attention to feasibility studies. Agencies using EDP should require management to take executive-type training courses on EDP systems.
5. A primary objective should be that of achieving a major breakthrough in the art of automatically programming electronic data processing systems.
6. Communications should be improved between agencies in regard to problems of staffing electronic data processing systems.
7. There should be more widespread recognition and use of the ability of experts in other fields to learn and perform EDP programming.
8. A periodic reporting system should be designed to cover the personnel aspects of electronic data processing systems.
9. EDP personnel costs should be subjected to the same degree of cost control as equipment costs.
10. EDP reporting should be standardized.
11. A negative attitude has existed in some agencies concerning the purchase of electronic data processing systems, and the tendency should be overcome. Judgment should be based on facts and not upon psychological factors such as the relative ease or difficulty of obtaining congressional approval for appropriations.

12. Studies made by the General Accounting Office should be carefully considered. They show an advantage in purchasing EDP systems under certain conditions and call for consideration not only from Defense point of view, but also, from that of the entire government.

13. Further studies should be conducted to reconcile the extremely divergent points of view concerning purchase versus lease of electronic data processing equipment.

14. Management should maintain a posture which supports and facilitates execution of the ultimate EDP procurement decision when it is based upon the facts.

15. Greater use of time payment plans for the purchase of EDP systems should be considered, and the feasibility of the design and introduction of improved time payment plans, including any needed legislation, should be determined.

16. Present Government standardization efforts, while a step in the right direction, are not sufficient to the challenging tasks to be performed and should be strengthened substantially.

Implications for the Future

The future of automatic data processing is extremely challenging. The technological advancements in computers are certain to continue. Computers should have more impact upon mankind than the explosion of the first atomic bomb because the impact of computers will affect people in every walk of life. The computer, by its very speed and ability to solve in moments more and more complex problems, provides the key to new knowledge.

As technology progresses in the data processing art completely integrated systems will be developed. Computer

language will be standardized, and machine-to-machine transmissions will be possible. Already equipment is being developed to take human voices as source data, and machines are already on the market, called optical scanners, which will revolutionize many repetitive, routine tasks when they come into widespread use.

Progress in the computer field will lead to smaller, less costly equipment. Third generation machines now in production require less space, no air conditioning, and less electrical power. Desk-sized computers may one day be in widespread use.

The development of computers for management will provide more information than ever before. Experience in the business application areas will provide vital information to the untapped and fertile field of scientific management by computers.

Improvement of communications will continue so that data processing techniques will provide real-time information to management in all areas of management concern.

The Defense Department, long a pioneer in data processing, will be among the first organizations to use computers for total management control. There will probably be a trend toward recentralization as operations researchers assume more of middle

manager's role in Defense. Random access computers will provide information on the qualifications and capabilities of every person in the Defense Department, military and civilian alike. Billets will be filled by machine screening of all qualified persons in the Defense establishment, and the selection of the person best qualified for a particular job.

The future should reveal significant improvement in management of automatic data processing systems. Management sciences should be used to greater advantage and fully automatic information systems will come of age. Managers will find themselves possessors of far greater knowledge, and knowledge is power, today as always.

What computers can do, and do best, is enable management to have at its command the fundamental prerequisite of all control and real power: the ability to gather and use information.

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